DIY

Worthwhile projects you can build on your own

1:1 current balun

Many hams are interested in building a variety of dipole antennas, including trap dipole, multi-band parallel or cat whisker dipole, even ordinary dipoles, partly because they're easy to construct for a 50-ohm feed line. But their DIY ease often comes at the price of *common-mode current*, which travels on the outside of the coax (coaxial cable) shield, where RF current doesn't belong.

This undesirable electrical phenomenon can result in feed line radiation (your dipole coax should not normally radiate), RF in the shack, distorted transmission patterns, and excessive noise during reception. Yes, your coax shield can act like a receiving antenna for noise, especially that originating within your home.

Common-mode current originates from either *conducted current* (result of the wave step function as the current reaches the antenna ends) or the *induced current* (result of the antenna radiating onto the coax, or both. You can see a laboratory demonstration of the effects of common-mode current on the feed line and even the power cable in this short video.

One way to mitigate or just minimize the effects of common-mode current is by the use of a *1:1 current balun*, often synonymous with an *RF isolator*, which is not difficult to build, and will have very little effect on your SWR. The key to an effective balun lies in the type of material used in the transformer core for the frequency range of choice. Since this balun will target most HF bands at 100 watts, an optimal choice is the Fair-Rite FT240-31 toroidal core. Some parts of this design were taken from HFKits and some from Tom Rauch W8JI.

Parts list

One toroidal FT240-31 ferrite core

One 4.7″ x 3.2″ x 2.6″ enclosure

Two 14 AWG #8 stud ring terminals

One 14 AWG #4 stud ring terminal

Two #8 screws, wing nuts, washers, split washers

One SO-239 bulkhead connector

72 inches of 22 AWG zip wire

One 1-½″ x 3/16″ eye bolt

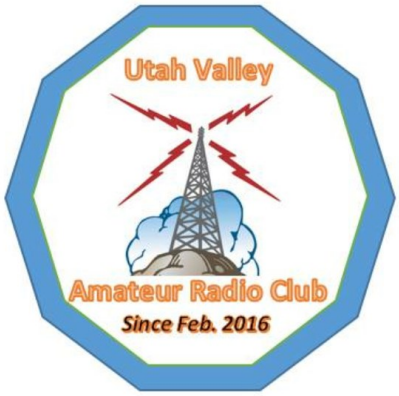
4 each M3 screws, split washers, nuts

One 1-3/8″ x 2-7/8″ fiberglass screen

FT240-31 ferrite core

Zip wire

Enclosure



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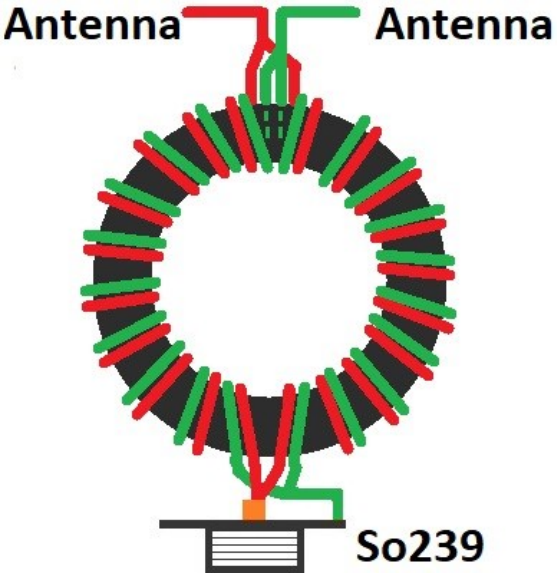
Coil assembly

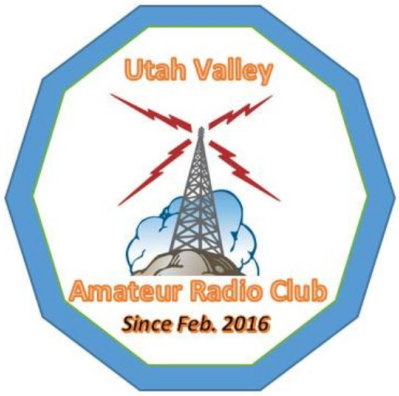
The diagram to the right shows what we're trying to accomplish. The purposes of this design are to a) maximize common-mode current reduction, b) minimize losses, while c) maintaining a 50-ohm impedance on both ends of the balun d) for a wide range of frequencies e) on 100 watts of transmit power.



Secure one end of the 22 AWG wire pair to the toroid with a small zip tie. Wrap the zip wire around one half of the toroid ten times, as shown:

Repeat this on the other half, but in an exact mirror image of the first. This way, the red wire is on the right with the first half, and on the left with the second half. It's not necessary to wind the wires perfectly straight on every turn; close enough will be good enough. The main thing you're striving for, is to wrap each wire such that it's about as tight on the toroid as you can get it, with no overlap in any of the wires.

For reference, let's call the ends of the wires at the top of these photos the ***antenna end***, and the other end the ***transceiver end***.



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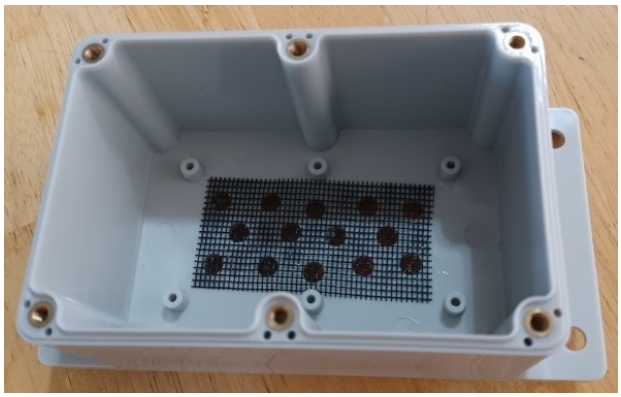
Strip all eight wires. Solder the two red wires of the antenna end to a #8 ring terminal, and solder the two black wires of the same end to another #8 ring terminal. Solder the two black wires of the transceiver end to a #4 ring terminal and solder the two red wires of the same end twisted together. Set the coil aside for now.

Enclosure assembly

Drill eleven to fourteen ¼″ holes in the back of the enclosure, for ventilation. Cover the holes by super-gluing the fiberglass screen over them on the inside, to prevent insects and debris from entering the enclosure.



Drill a ½″ hole in the enclosure at one end I'll call the ***balun bottom***. Place the solder cup end of the SO-239 bulkhead into the ½″ hole on the outside of the enclosure, and using the four mounting holes of the bulkhead as a template, drill a 1/8″ hole for each mounting hole. Assemble the bulkhead onto the enclosure using the M3-0.5 mm hardware.

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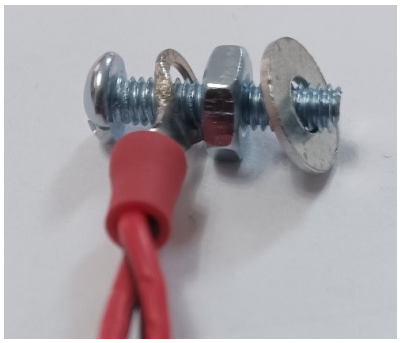
Drill a 3/16″ hole in the ***balun top***, about 1-¼″ from the back of the enclosure. Install a flat washer onto a 3/16″ eyebolt, and slip the eyebolt assembly through the hole. Secure the eyebolt with a split washer and another nut. This eyebolt can be used to hang the balun and relieve some of the strain on the wire elements due to the weight of the balun and the coax.

Drill two 3/16″ holes on opposite sides of the enclosure about an inch below the balun top (the end opposite that of the bulkhead connector). For each side, install a #8 machine screw through one of the #8 ring terminals of the coil antenna end, screw on a nut, then a flat washer, then insert the screw assembly through the 3/16″ hole from the inside. Install another flat washer, nut, and wing nut onto the same machine screw on the outside of the enclosure.



Severed PL-259 connector used as a heat sink

Plug a PL-259 connector into the SO-239 bulkhead, for a heat sink. If you don't plug in a connector, soldering the cup in the rear of the bulkhead can get hot enough to melt the dielectric, especially if you're using a low-wattage (under 60 watts) soldering iron. At the transceiver end of the wired toroid, lay the coil comfortably into the enclosure and solder the two red wires to the center soldering cup of the bulkhead. Bolt the #4 ring terminal of the two black wires to one of the M3-0.5 screws of the bulkhead.

Secure the coil to the inside of the enclosure, if you feel it's necessary.

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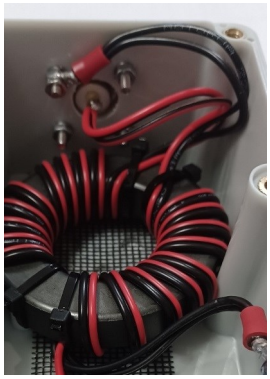
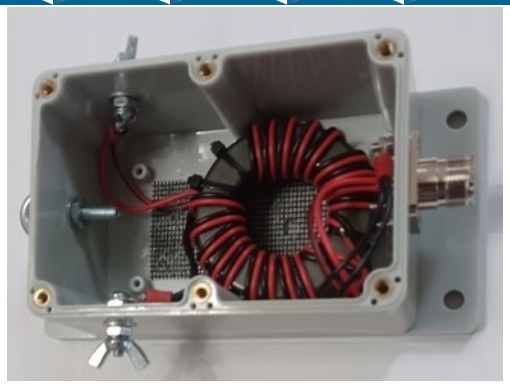
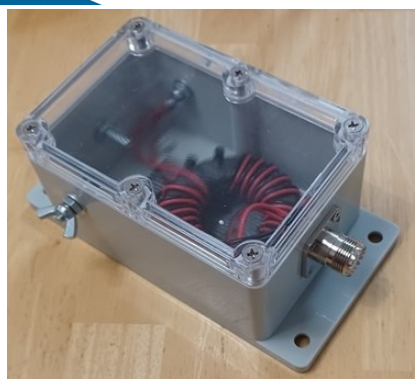
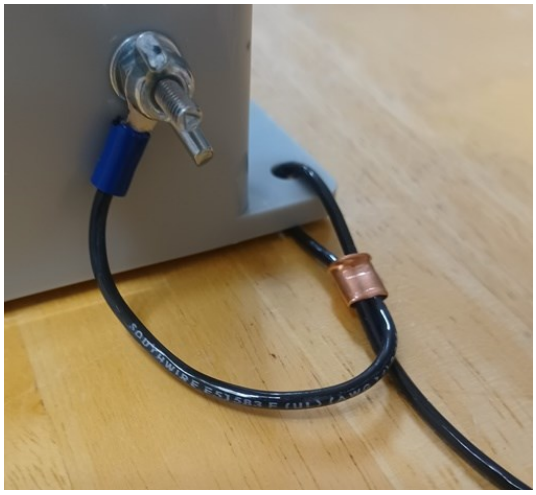






Install the enclosure cover, and the balun construction is complete.

How to use it



Replace your dipole center insulator with this balun, to prevent common-mode current from taking over your station and turning your QSOs into an unpleasant experience. It should be able to handle up to 150 PEP watts of transmit power, from 80 meters through 10 meters.

To use it with your dipole, slip an antenna element wire through a crimp sleeve, through the enclosure external mounting hole, then back through the crimp sleeve. Solder a #8 ring terminal to the wire end, and secure the ring terminal to the #8 machine screw by the wing nut on the side of the balun. Ensure the crimp sleeve allows for enough wire room to keep strain off the ring terminal, then crimp the sleeve. Repeat all this on the other side.

You can place this balun outside, even in the rain. Be sure to wrap your coax connector with silicone seal, to keep moisture from entering your coax at that junction. To make it completely waterproof, you should cover the SO-239 bulkhead inside the box with hot glue or similar.

Summary

The 1:1 current balun is a passive choke that helps prevent common-mode current from causing your coax to radiate and making your coax shield into an antenna. It's fairly easy to build, yields great benefits, and won't appreciably increase your SWR. If you're using a dipole-type antenna, you can make plenty of contacts without this device, but if you're experiencing a lot of consistent noise from your antenna, the 1:1 current balun might just be in your future.

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